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Finer Points

SUPERABRASIVE INDUSTRY REVIEW

Applications in Polycrystalline Edge Prep, Diamond Highway Grinding & CO2 Grinding Systems

THIS ISSUE

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Education Course Announcement

INTERTECH Announcement & Call For Papers

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Tool Edge Preparation Advances

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News & Notes

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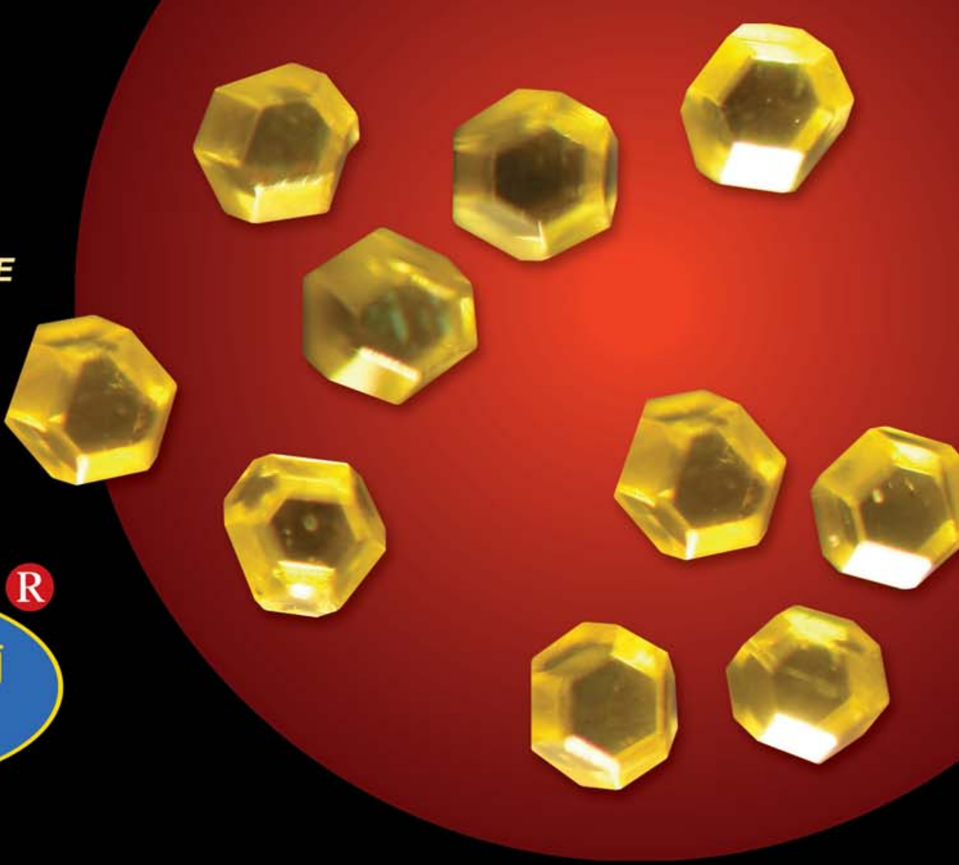

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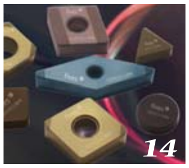
COVER PHOTO

Photo courtesy of Crystallume Engineered Diamond Products. Crystallume's new "Stealth" end mill is the sharpest diamond coated end mill available anywhere. Crystallume's continuous ability to deliver ground-breaking tooling solutions is being displayed with two new tool lines. Crystallume's revolutionary new hard milling tool line, Demon, cuts molds in the most difficult materials for up to 450% longer, and completely eliminates the need to switch tools midway through an application. Demon tools generate less heat, hold size, and cut the part within tolerance, as well as reduce, or even eliminate, the need for polish. Founded in 1984, Crystallume pioneered the development and application of Chemical Vapor Deposition (CVD) diamond technology.

FINER POINTS is the longest running publication devoted exclusively to the understanding, selection and application of diamond, cubic boron nitride and related materials. It is edited for recipients who are involved in some way with these "superabrasives", either as providers of the materials, producers of products containing the materials or users of these products (e.g., grinding wheels, dressing tools, drill bits, saw blades, sawing wires, cutting tools, polishing compounds, CVD film products, etc.).



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A Finer Point of View…

Well, I guess I proved my point in the last edition of Finer Points … It is a fact that few recipients, if any, rarely read the letter from the President.

I did not receive any contact or comments for my intentional ruse of offering an all-expense spa holiday in Aleppo Syria.
(I wonder why?)

More importantly, as current President of the IDA, I would like to think that I can achieve an outreach to the members of the Industrial Diamond Association and perhaps impart some useful information.

In order for the IDA to remain an integral part of the promotion and growth of the Superabrasives Industry in general, we need the active engagement and participation of all members. Some contributions are great, others small, but all are vital and welcome.

The IDA Board of Directors has been working diligently with many individual committee members to implement and refine another Education course offering. We have had tremendous support and content suggestions from a wide range of technologists and experts to make sure this course improves with every offering! The course name should be a clear message as to the content … ***Superabrasives Materials, Principles and Applications*** says it all!

The course will again take place at the YG-1 America Advanced Manufacturing Center in Charlotte, North Carolina on November 16 and 17. I would like to thank YG-1 and its employees for hosting this IDA sponsored event and for helping to make this education course an important experience in the understanding and advancement of our industry. This course and the facilities were well-received by all the participants last year.

PRESIDENT
Ben Williams

And of course, the IDA continues to present its signature, biennial, technical conference; INTERTECH, which will take place April 20-22, 2017. There are plenty of references and full information found in this edition of Finer Points.

INTERTECH is a forum whereby research and development, new subject matter, emerging technologies, ideas and thesis can be unveiled and presented to your industry colleagues. It is also an excellent forum for meeting and talking with your peers in the industry … Brainstorming and Networking to a new level!

These two educational events are an opportunity for you and your company to become active participants in the Industrial Diamond Association of America in every form. Attendance and presentations at these events provides the opportunity to learn about the latest technological or product developments and to encourage and promote the use and growth of superabrasives

I hope to see many of our Association Members and the Finer Points readership there.

Sincerely,

Ben Williams, IDA President 2016
Industrial Diamond Association of America

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FINER POINTS is the official publication of the Industrial Diamond Association of America, Inc. and is published fours times a year. Contributions are welcomed but the Editor reserves the right to accept or reject any material deemed inappropriate for publication. All by-lined articles published in this magazine represent solely the individual opinions of the writers and not necessarily those of the Industrial Diamond Association. Executive and Editorial Offices: Finer Points, P.O. Box 29460, Columbus, Ohio 43229, (614) 797-2265. Editor and Advertising, Terry Kane. Advertising rates and deadlines available upon request.

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IGGA Research Summary

Diamond Grinding Slurry Not Detrimental To Soil Over The Long-Term Term

RESEARCH CONDUCTED BY NDOR DEMONSTRATES THAT SLURRY APPLICATION ON ROADWAY SHOULDERS IS SAFE

WHEN DIAMOND GRINDING concrete highways, water used to cool cutting blades combines with hardened cement paste and aggregate particulates, generating a byproduct known as concrete grinding residue (CGR), or slurry.

Some state environmental departments have expressed concerns related to the deposition of slurry on the roadside and have begun to establish limits on how much slurry can be discharged onto the roadside during the grinding process. However, because slurry disposal is costly for state DOTs — and for taxpayers — researchers are now working to identify CGR's precise ecological effects, as well as how CGR disposal can b optimized.

Investigators from the Department of Agronomy And Horticulture, University Of Nebraska-Lincoln, recently prepared a report titled, "Evaluation of Concrete Grinding Residue (CGR) Slurry Application on Vegetation and Soil Responses along Nebraska State Hwy 31" for the Nebraska Department of Roads (NDOR). The two year study evaluated the effect of CGR application on soil chemical properties, existing vegetation and rainfall runoff. Tests were conducted along two state highway sections, one consisting of loam and one consisting of silt loam soils. The CGR effective calcium carbonate equivalent (ECCE) ranged from 13 to 28 percent.

CONTROLLED RATE APPLICATION EXPERIMENTS

Researchers took road shoulder slope measurements along NE State HWY 31, between mile marker 28 (MM28) and MM36, to identify locations with uniform vegetation and adjacency to flat road areas. Sites selected for field experiments had an average slope of 21.3 percent for MM36, and 12.5 percent for MM34. Vegetation for all locations was predominantly cool season grasses. Soil textural classes were from loam to silt loam at the two sites with pH > 7.0.

Slurry used for the MM36 experiment was collected in barrels from a diamond grinding operation in Grand Island, Nebraska in October 2012 and stored in a temperature controlled environment. Slurry used at the MM34 site was collected in a Ready-mix truck from a diamond grinding operation in Elkhorn, Nebraska in May 2013 and was transferred to barrels and similarly stored.

Prior to experimentation, all slurry was air-dried, mixed to homogenize and rewetted to approximate water content on an actual diamond grinding operation. Slurry density was estimated, using various methods, to be 10.3 lb gal-1 – 10.8 lb gal-1. Following EPA method 200.7, laboratory procedures were undertaken to determine:

- moisture of the dried slurry to adjust application rate
- ECCE
- potassium, calcium, magnesium and sodium concentrations (percent by weight)
- heavy metal content (arsenic, cadmium, cobalt, copper, molybdenum, nickel, lead, mercury, selenium and zinc)

In July 2013, controlled slurry treatments were applied at locations along Nebraska State Highway mile marker 36. The application rates of dry slurry (0% moisture) were 0, 4.1, 8.2, 16.4 and 32.9 tons/acre for each treatment. Multiplying by an average effective calcium carbonate equivalent (ECCE) of 13 percent, slurry rates applied were converted to lime equivalent rates. These rates were 0, 0.5, 1.1, 2.1, and 4.3 tons lime equivalent/acre respectively.

In June 2014, slurry treatments were applied along Nebraska State Highway mile marker 34. Application rates of dry slurry (0% moisture) were 0, 5.5, 10.9, 21.8 and 43.7 tons/acre for each treatment. With an average ECCE of 28 percent, the lime equivalent rates were 0, 1.5, 3.1, 6.2, and 12.3 tons lime equivalent/acre respectively. At both sites, dried slurry was mixed with water to achieve a density of 10.5 lb gal-1. Slurry was applied by hand.

ABOUT IGGA

The International Grooving & Grinding Association (IGGA) is a non-profit trade association founded in 1972 by a group of dedicated industry professionals committed to the development of the diamond grinding and grooving process for surfaces constructed with Portland cement concrete and asphalt. In 1995, the IGGA joined in affiliation with the American Concrete Pavement Association (ACPA) to form what is now referred to as the Concrete Pavement Preservation Partnership (IGGA/ACPA CP3). The IGGA/ACPA CP3 now serves as the lead industry representative and technical resource in the development and marketing of optimized pavement surfaces, concrete pavement restoration and pavement preservation around the world.

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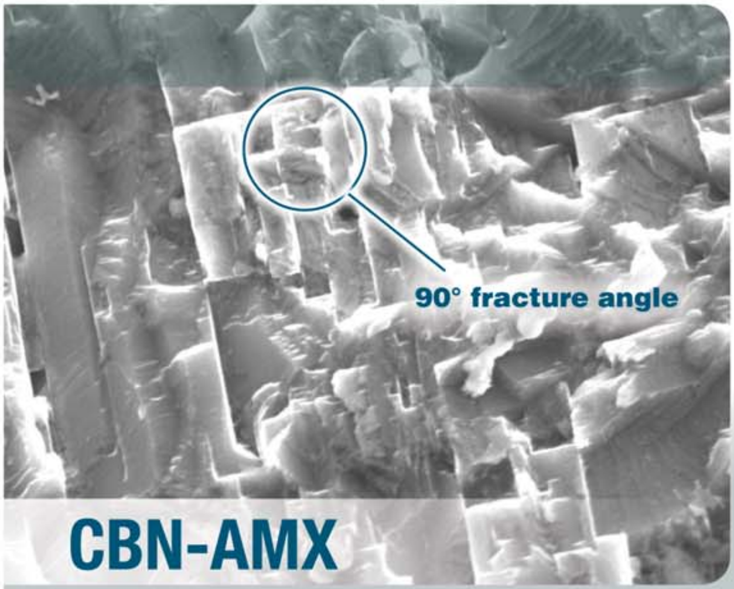
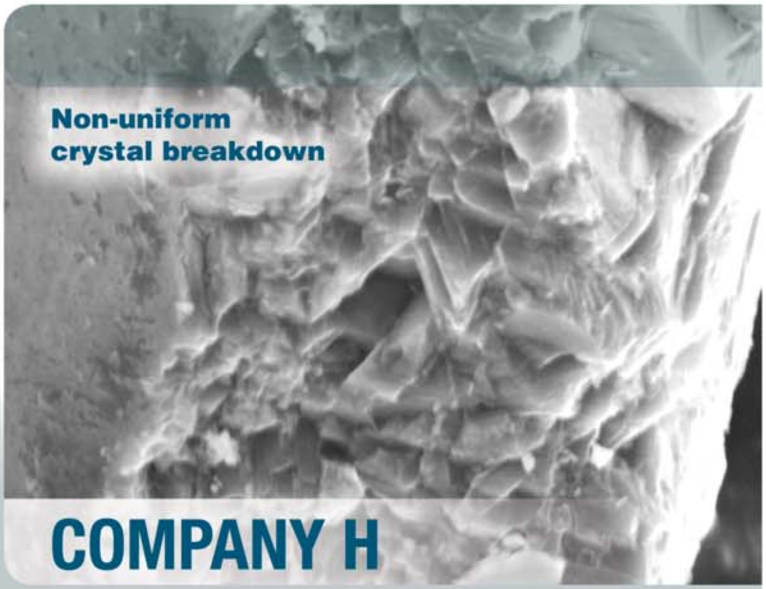
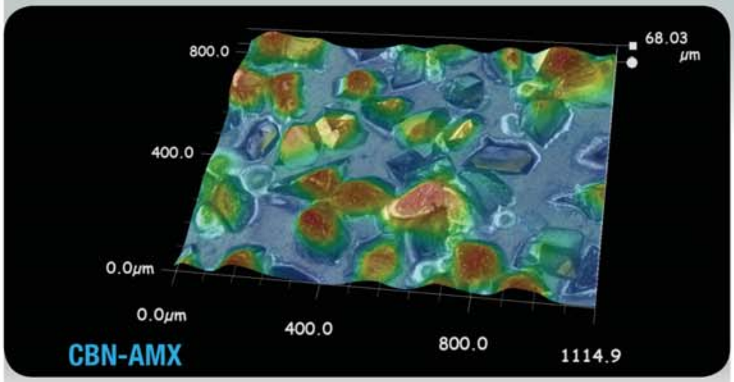
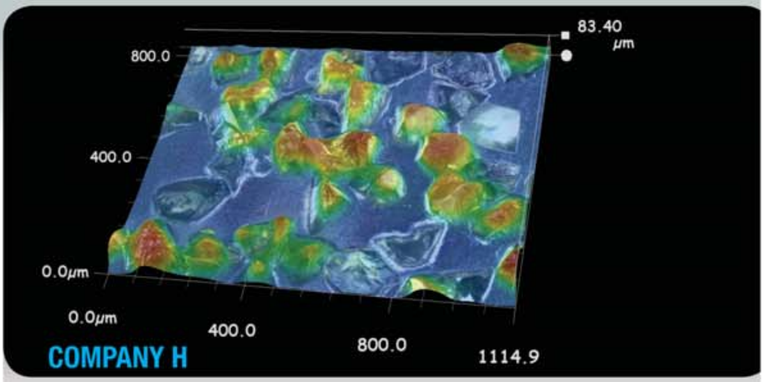


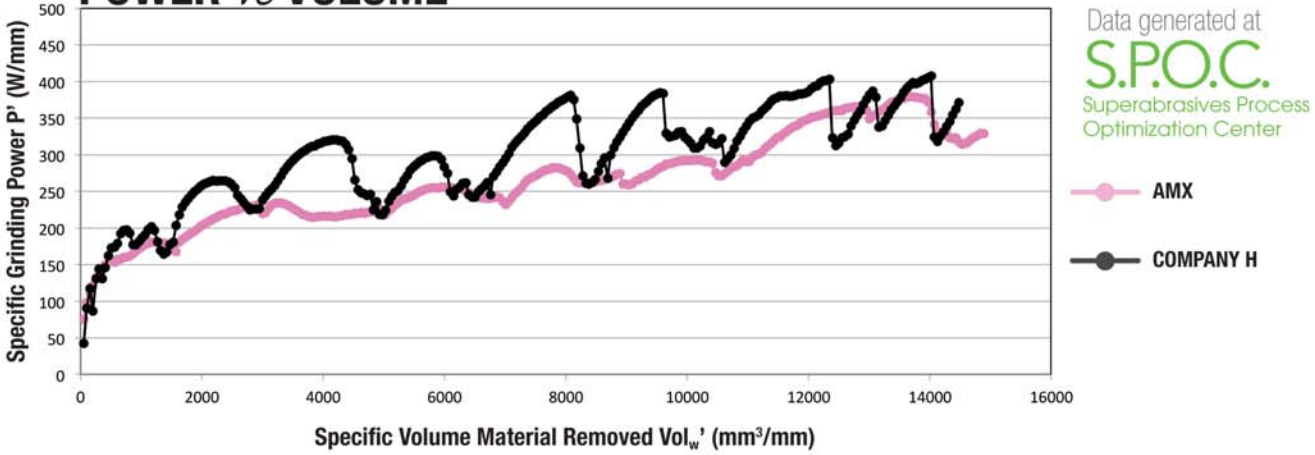


- **these crystals were removed from electroplated CBN wheel's (same manufacturer) after grinding 15,000 Specific Volume Material Removed Vol ' (mm3 /mm) of Inconel 718**
- **note the consistent 90 degree fracture mode fracture mode for the AMX which directly relates to the long, consistent grinding cycles (note in the Power vs. Volume chart below)**
- **note that the AMX (Pink line) consistently draws lower power and provides a more free cutting crystal**
- **note that the Competitor H crystal, also removed after grinding the same amount of workpiece materials, exhibits a non-uniform crystal breakdown that is clearly exhibited in the Power vs. Volume chart**





POWER *VS* VOLUME



Data generated at
S.P.O.C.
Superabrasives Process Optimization Center

RESULTS

For both the 2013 and 2014 one time CGR slurry application, no change was observed in runoff volume, runoff chemistry, ground cover or species composition. The highest CGR application increased soil sodium and pH in short term (one month) but did not persist after one year of CGR application.

Nebraska currently disposes of CGR in accordance with the Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES) Permit Program. According to the permit, CGR roadside application is restricted to 5 dry tons/acre.

Test results demonstrated, however, that the 5 ton/acre limit may be too restrictive. The maximum rate of application during testing was 40 dry tons/acre. While this amount, eight times the current limit, did raise pH, calcium and sodium levels one month after application, testing after one year showed that overall, the higher CGR discharge rate did not have a significant negative effect on soil. Study authors did recommend measurement of existing conditions and the development of field tests that will allow for adjustment of CGR application rates. They also caution that application rates must consider the ECCE, moisture of the CGR and roadside soil texture.

SUMMARY

The study authors concluded that CGR discharge of up to 40 dry tons/acre can safely be applied in a uniform layer one time to roadsides with medium textured soils. For more information, read the University of Nebraska-Lincoln/NDOR report here.
http://ntl.bts.gov/lib/56000/56200/56214/FinalReportM335.pdf ■

TABLE 3.19: Consequences of one time CGR slurry application effects based on two site experiments, with loam and silt loam soil textures, at NE State HWY 31 sites in 2013 and 2014.

Property	**Observed Change**		**Comments**
	Yes	**No**	
Runoff Volume			
Runoff Chemistry			
Ground Cover			
Species Composition			
Soil pH	x	x	pH increased at 20 and 40 tons after one month but effect did not persist after one year.
Soil EC	x		Immediate increase that did not persist after one year.
Soil Ca	x		Ca increased at 20 and 40 tons after one month and effect was persistent after one year.
Soil Na	x		Immediate increase that did not persist after one year.
Soil K	x		Possible decrease due to excess Ca load.
Soil Mg		x	Possible decrease due to excess Ca load.
Soil Heavy Metals		x	Not measured but most are below threshold level in CGR slurry.

Table Reprinted With Permission.

Mamo, M., D. McCallister, W. Schacht, A. Wingeyer. 2015. Evaluation of Concrete Grinding Residue (CGR) Slurry Application on Vegetation and Soil Responses along Nebraska State Hwy 31. Final Report Prepared for the Nebraska Department of Roads (NDOR). NDOR Project #SPR-P1(13)M335)

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- Truing & Dressing Applications
- Grinding Demonstrations and Surface Analysis
- Machining of Exotic Materials
- Thermal Testing & Evaluations
- And More!

OBJECTIVE

"Superabrasive Materials Principles and Applications" is sponsored by the IDA and designed specifically to educate on the use of industrial diamond, cubic boron nitride (cBN) materials classified as superabrasives. It is non-commercial, unbiased and representative of accepted principles and practices. Content will include a wide range of products and applications for the automotive, aerospace, medical, electronics, optics and other industries using superabrasives. The attendee will be educated in the primary areas of grinding and machining with peripheral explanation for other uses, such as non-abrasive applications.

WHO SHOULD ATTEND?

This Course will educate End Users processing materials made from difficult to machine and grind materials such as ***hardened steel, stainless steel, superalloys, titanium, high silicon aluminum, composites, ceramics, bi-metals, metal matrix composites, cermets, glass, and more!*** It will also educate Machine Tool Builders, Abrasive suppliers, Raw Material Suppliers, Machine Operators, Wheel Makers, Tool Makers, Research Scientists, Academia, Engineers, Sales Personnel or anyone wishing to learn more about superabrasives.

INSTRUCTORS ARE INDUSTRY EXPERTS WITH MANY YEARS COMBINED EXPERIENCE!

Each one has “real world” knowledge of superabrasives, applications and characteristics. They have already established manufacturing operations in aerospace, automotive and literally every other production operation around the world. Now, you can learn what superabrasives are, where they are used and the characteristics and properties that affect their performance in manufacturing operations. Do you want to understand wear mechanisms in machining and grinding? What is friability? What is a rake angle? What affects chip formation? What crystal is used in a given application? How does burn and thermal damage affect structural integrity of a part? What is residual stress in metal components such as turbine engine fan blades? Why true & dress a wheel? What are the different coolant types and delivery systems? What is edge prep on a cutting tool and why is it performed? What is the Modulus of Resistance and what abrasive performs best on a particular workpiece material and why? If you currently are using conventional abrasives you will learn the advantages of superabrasives and how they can be applied to increase productivity, reduce scrap and improve the cost effectiveness in manufacturing operations.

World Renowned Industry Grinding Expert Jeff Badger, “The Grinding Doc” will be a featured presenter.

About the Grinding Doc

Dr. Jeffrey Badger is an expert in the industrial process of grinding. He works independently as a consultant, helping companies around the world improve their grinding operations and troubleshooting grinding problems. He has worked in grinding facilities in over 30 countries. Dr. Badger is the author of the regular question/answer column "Ask The Grinding Doc" in Cutting Tool Engineering. He is well known for his practical, down-to-earth, yet high-tech approach to the subject.

William Shaffer, President of Conicity Technologies will be a main presenter demonstrating proper edge preparation for polycrystalline cubic boron nitride (PcBN) and polycrystalline diamond (PCD).

The tool edge preparation process, when administered properly, adds strength to the tool cutting edge, lengthens usable tool life, minimizes the propensity of the edge to chip, improves part quality and consistency, and enhances work piece surface finish. With the new workpiece materials bombarding all industries and the ability for CNC machines to run in a "flat-out" untended environment, the performance demands are increasing on cutting tools. The need to produce more predictably performing tools is paramount to the industry.

Attila Szucs, President of Advanced Superabrasive, Inc., the Industry Leading Manufacturer of Truing & Dressing Machines will be instructing on truing and dressing and providing live demonstrations.

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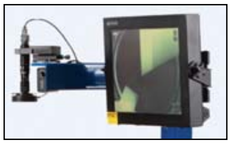

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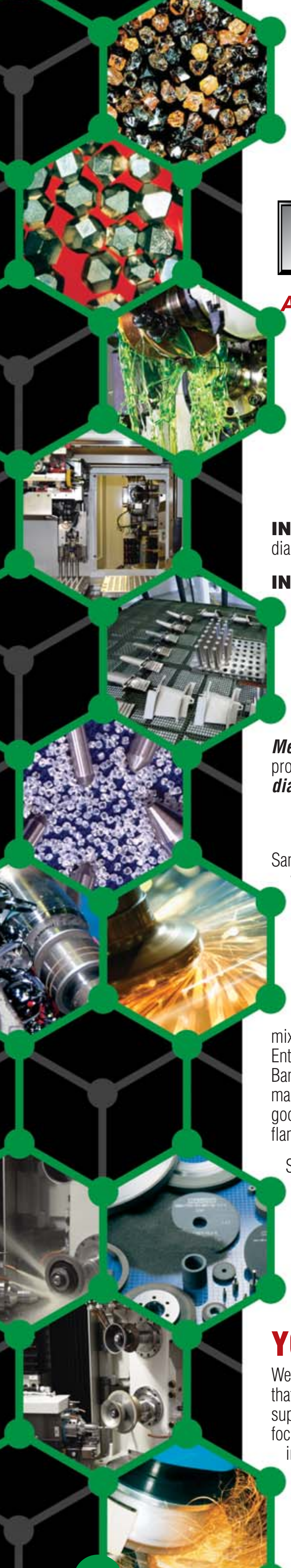

The Industrial Diamond Association of America Announces INTERTECH 2017 April 20, 21 & 22, 2017

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INTERTECH 2017 WILL BE THE FEATURED CONFERENCE FOR NEW TECHNOLOGY AND APPLICATION DEVELOPMENT OF SUPERABRASIVES AND SUPER-HARD MATERIALS

INTERTECH 2017 is the leading International Technical Conference on industrial diamond, cubic boron nitride, polycrystallines, CVD diamond, CVD Cubic Boron Nitride, Nanodiamond and other materials classified as superabrasives and ultra-hard materials.

INTERTECH 2017 will serve as a forum for leading experts representing international suppliers, manufacturers, research facilities, academia, end users, machine tool builders and the scientific community. They will be presenting papers on subjects that will introduce new and thought provoking technology on industrial and commercial levels. This will be an international "meeting of the minds" for every aspect of ultra-hard material science.

MATERIALS FEATURED THEME

Today's components in major industries like Aerospace and Automotive are made of exotic and difficult to machine and grind materials such as ***Titanium, High Silicon Aluminum, Superalloys, High Tech Ceramics, Ceramic Matrix Composites (CMC), Metal Matrix Composites, Carbon Fiber Composites, High Silicon Aluminum, Bi-Metals, Glass, Cermets and others***. In production operations these materials require the high productivity, close tolerances and ***superior performance attainable only by diamond and cBN tooling*** for machining, grinding and other material removal and finishing operations.

SAN FRANCISCO IS A MAJOR ATTRACTION…

San Francisco is The City by the Bay and renowned as The Paris of the West. It is one of the most famous American cities and overflowing with cultural and historical wealth. **INTERTECH** has been held in many locations over the last 16 years and in 2017 this sensational event will be held in San Francisco, California USA. **INTERTECH** is known for excellent locations and exceptional service and **INTERTECH 2017** will carry on that tradition at the San Francisco Airport Marriott Waterfront. We are anticipating the usual excellent attention and personal service that has become the standard of **INTERTECH** conferences. The Marriott boasts beautiful accommodations, magnificent meeting rooms and luxurious amenities. San Francisco is the cultural, commercial, and financial center of Northern California and the fourth-most populous city in the state. The California Gold Rush of 1849 brought rapid growth, but three-quarters of the city was destroyed by the 1906 catastrophic earthquake and fire. San Francisco was quickly rebuilt and has become known for its steep rolling hills, eclectic mix of architecture, and landmarks, including the Golden Gate Bridge and the former Alcatraz Federal Penitentiary. Entrepreneurs sought to capitalize on the wealth generated by the Gold Rush with the founding of Wells Fargo and the Bank of California. Development of the Port of San Francisco and the establishment of the overland rail system helped make the Bay Area a center for trade. Catering to the needs and tastes of the growing population, Levi Strauss opened a dry goods business and Domingo Ghirardelli began manufacturing chocolate. San Francisco is a major city known for its flamboyant style, stately hotels, ostentatious mansions on Nob Hill, and a thriving arts scene.

San Francisco's Chinatown is the oldest and one of the largest in North America. The historic center of San Francisco is the northeast quadrant of the city anchored by Market Street and the waterfront. It is here that the Financial District is centered, with Union Square, the principal shopping and hotel district nearby. Cable cars carry riders up steep inclines to the summit of Nob Hill, once the home of the city's business tycoons, and down to the waterfront tourist attractions of Fisherman's Wharf, and Pier 39, where many restaurants feature Dungeness crab from a still-active fishing industry. Also in this quadrant are Russian Hill, a residential neighborhood with the famously crooked Lombard Street, North Beach, the city's Little Italy and Telegraph Hill, which features Coit Tower.

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We are now soliciting commercial and technical papers of approximately 30-45 minutes in length that address the research of these super-hard materials as well as the dynamics and application of superabrasive systems in automotive and other industries as well (see: Areas of Consideration) with a focus on new technology, tooling, workpiece materials, machines and applications related to increased **PRODUCTIVITY** and **PERFORMANCE**. Consideration for papers is being made at this time and abstracts are now being accepted; contact us today to be considered. This will be the most comprehensive event ever held on diamond and cubic boron nitride superabrasives used to machine and grind exotic and difficult to work raw materials for components in major industries like Automotive, Aerospace and similar industries!

Photos of San Francisco for INTERTECH 2017 courtesy of San Francisco Convention & Tourism Bureau.

AREAS OF CONSIDERATION FOR PAPERS FEATURING PAPERS ON SUPERABRASIVES AND RAW MATERIALS

SUPERABRASIVE MATERIALS
- Mesh Diamond
- Mesh Cubic Boron Nitride (CBN)
- Polycrystalline Diamond (PCD)
- Polycrystalline Cubic Boron Nitride (PCBN)
- Wire Dies (large crystal and polycrystalline)
- CVD Diamond
- CVD CBN
- Nanodiamond
- New Crystals

MACHINE TOOLS
- Development
- Innovations
- Advancements
- Superabrasive Application Designed Machines

RESEARCH & DEVELOPMENT
- New Crystals & Abrasives
- New Coatings
- Bond Development
- Testing/Gauging
- Tool Fabrication
- Materials
- Tooling
- Application Development
- HPHT Technology
- Film (CVD & PVD)
- Magnetorheological Finishing
- Electrolytic In-process Dressing (ELID) Mirror-Surface Grinding
- Nanotechnology

TOOLING
- Grinding Wheels
- Cutting Tools
- Sawblades
- Drill Bits

WEAR PARTS
- Rests
- Anvils
- Nozzles

WORKPIECE MATERIALS
- Metal Matrix Composites
- Bi-Metals
- High Tech Ceramics
- High Silicon Aluminum
- Wood & Wood Composites
- Glass
- Stone
- Concrete
- Titanium
- Cermets
- Stainless Steel
- Ceramic Matrix Composites (CMC)
- Carbon Fiber Composites
- New Materials & Alloys
- Thermal Sprays
- Superalloys (Hastelloy, Inconel, Waspalloy, Rene alloys, Haynes alloys, Incoloy and others)
- Nano-Structured Materials
- Hardened Steel
- Cast Iron

OTHER NEW TECHNOLOGY & APPLICATION DEVELOPMENT

MAJOR INDUSTRIES AND TOPICS FOR CONSIDERATION

AEROSPACE
- Manufacturing
- Rebuilding

AUTOMOTIVE
- Parts Manufacturing
- Gears
- Wheels
- Transmissions
- Engines

CONSTRUCTION/HIGHWAY
- Concrete Aggregates & Variables
- Highway/Runway
  - Grinding & Grooving
  - Bridge Repair
- Renovation
- Block Grinding
- Polishing

ELECTRONICS
- Disc Texturing
- Wafer Mfg.
- Polishing
- Optic Windows
- Semiconductors
- Heat Sinks
- Coatings

GLASS
- Lens Generation
- Polishing
- Pencil Edging

MACHINE TOOLS
- Development
- Innovations
- Advancements
- Superabrasive Adaptation

MEDICAL
- Surgical Knives
- Prosthesis Fabrication

MINING/DRILLING/NATURAL RESOURCE EXPLORATION
- Drills & Bits
- Application

NANOTECHNOLOGY
- Medical Developments
- Industrial Applications
- Electronics
- Other Research & Developments

OTHER MANUFACTURING
- Pumps
- Motors
- Heavy Equipment

OPTICS
- Polishing
- Lens Generation
- Diamond Coating

STONE PROCESSING
- Quarrying
- Sawing
- Polishing

SUPPLIERS TO SUPERABRASIVE INDUSTRY
- Raw Materials
- Coolants
- Chemicals
- Measuring, Gauging & Safety
- Pressing Equipment
- Other

WIND & TURBINES
- Gears
- Vanes
- Shafts
- Frames

WIRE DRAWING
- New Technology
- Applications
- Manufacturing

WOODWORKING
- Hard Woods
- Fiberboard
- Laminates
- Composites

OTHER NEW TECHNOLOGY & APPLICATION DEVELOPMENT

WATCH FOR INTERTECH 2017 ON-LINE

As you can see by the areas for paper consideration, diamond and cubic boron nitride are not just being used as abrasives in traditional applications. Today, superabrasives and ultra-hard materials are making inroads in electronics, medical, cosmetics and literally every other industry where the characteristics of diamond and cubic boron nitride can affect performance or provide higher strength or new capabilities. As an **INTERTECH** attendee you will learn how these new products and applications are being developed, where super-hard materials are being used and how you can apply these systems in new and innovative ways. Visit the **INTERTECH 2017** website: www.intertechconference.com for additional information on:

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ABSTRACTS WILL BE ACCEPTED FROM JULY 1, 2016 THROUGH JANUARY 1, 2017

We will reply to all submissions. Come join us! **INTERTECH** has the tradition of being the most comprehensive event held on superabrasives and ultra-hard materials.

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VOLLMER OFFERS A HIGH-TECH RANGE OF MACHINES WITH WIRE AND DISK ELECTRODES

The Vollmer eroding machine QXD 250 is just one of the machines that makes it possible for tool manufacturers to process more than 30 percent more PCD cutters in the same amount of time as has been the case up to now. This milestone in production is made possible by the generator technology Vpulse EDM, which sets the eroding beat at the heart of the QXD 250. Depending on the demands, the Vpulse EDM can increase the speed of the tool production or increase the surface fineness. The Vpulse EDM achieves these advances when processing PCD surfaces by using individually cycled eroding impulses. This corresponds to two-fold improvement and more in comparison to the eroding technology which have been available up to now. ***For more details visit: http://www.vollmer-group.com/us/us.html***

FULLERTON OFFERS TOOLING FOR 5ME CRYOGENIC SYSTEMS

Agreement makes Fullerton Tool Company an authorized producer of BlueZone™ tooling, including end mills and drills, for cryogenic machining systems.

SEPTEMBER 2016 – Fullerton Tool Company is now an authorized manufacturer and distributor of 5ME's BlueZoneTM Cryogenic tooling, after the two companies finalized an agreement that includes sales and support for carbide end mills and drills designed for use with 5ME's cryogenic machining systems. The agreement covers sales and service in the United States, Mexico and Canada. 5ME's unique, multi-patented cryogenic machining process enables higher cutting speeds, increased material removal rates, and longer tool life by transmitting liquid nitrogen at -321°F through the spindle/turret and tool body, directly to the cutting tool's edge. For more information on 5ME's cryogenic machining, go to http://5me.com. ***For more information on Fullerton Tool Company, go to http://fullertontool.com.***

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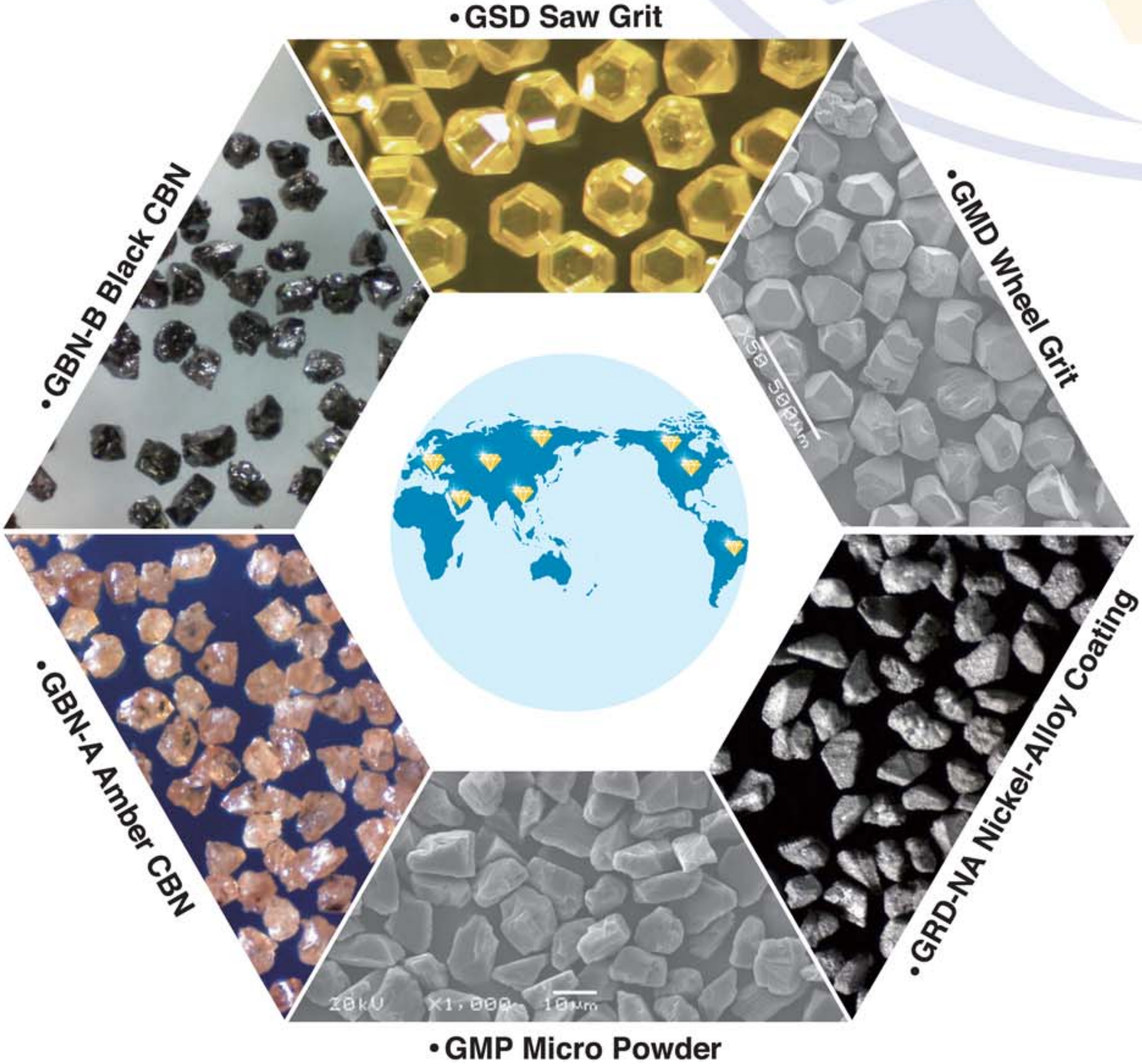

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PROCESS OPTIMIZATION FOR OLDER MANUFACTURING PLANTS: REPAIR, REPLACE OR RE-INVENT?

by Andrew Strong, Associate Director, Cambridge Consultants

As technology advances, the performance gap between modern, state-ofthe- art manufacturing facilities and older production plants becomes increasingly apparent. New installations may be bristling with sensors and continuous feedback loops that optimize the process on the fly (one component of so-called Industry 4.0 and the Industrial Internet of Things (IIoT). On the other hand, older manufacturing systems reflect technology and market conditions at the time when they were built, relying on experienced operators and maintenance teams, manual adjustments and post-production quality checks. Increasingly, we witness those older plants suffering from comparatively poor utilization, production throughput and yields; these factors and their impacts on operating costs reduce the ability of the manufacturer to compete effectively. Their markets are often facing increasing competition from elsewhere and the emergence of robotic manufacturing and further automation. Often, manufacturers simply accept the limitations of their existing equipment; the classical alternative is to make a major capital investment in new manufacturing machinery. However, there are many cases where a smaller investment can offer the prospect of increased manufacturing performance through science-led engineering and some carefully selected novel process monitoring and optimization. Some key examples of this include:

On-Line Product Monitoring

Many QC systems involve measurement of samples of finished product; whilst a batch test is performed, continuous manufacturing processes can produce large volumes, exposing the manufacturer to the risk that a significant volume of out-of-specification inventory is produced whilst the test is in progress. Using novel sensor combinations and technologies transferred from other industries it is often possible to perform a close equivalent to the final QC measurement, but with the advantage that it is on-line, real-time and at little or no risk to the production process. This provides two key advantages. First, the moment the out-of-specification product is detected, the operator can take action to mitigate the problem or abort the process to eliminate further waste. Second, the continuous feedback can be used to provide real-time control of critical processes and improve production consistency and hence yield.

Applying The Latest Sensing Approaches To Key Process Parameters

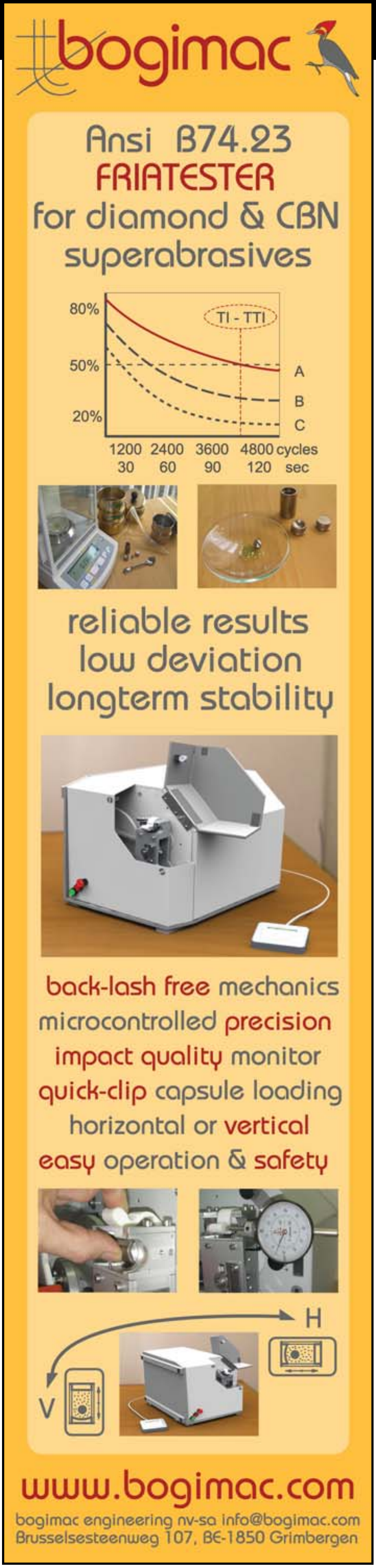
Most processes have a handful of key parameters or machine settings that are critical to successful operation. If these are not monitored sufficiently well (or are perhaps open to casual operator 'fiddling'), then they cannot be considered to be well-controlled. The application of online monitoring can bring much-improved process understanding and control with a direct improvement in process performance.

Characterizing Manufacturing Processes

Older manufacturing equipment often relies on the gut feel of a highly experienced individual for its setup and maintenance. This reliance on an individual presents a risk to the operation; techniques to apply rigorous engineering and analytics (capturing information on process temperatures, alignments, vibrations and acoustic signatures, motor currents and other critical parameters, correlating these with normal operation and various fault conditions) can quickly identify normal operating settings and conditions and then permit much more straightforward setup and fault diagnostics. This can even begin to extend to predictive maintenance. In our work with major manufacturers in a number of industrial segments, we witness a spectrum of technologies from those that have changed little in decades, to those which represent significant investment in the latest equipment.

It is perhaps surprising that there remain many manufacturers who continue to operate as they have done for many years and who are unaware of the value (in straightforward return on investment) of a fresh engineering approach, based on current commercial off-the-shelf sensing and control technologies. Before continuing to accept mediocre manufacturing performance or writing off an aging plant it is worth exploring the technology and measurements that are becoming available which, when applied appropriately, could have a dramatic effect on understanding and control of a production process. In particular, it is worth considering the options to buy, build, adapt or innovate to improve existing machinery and how to identify the innovations that could deliver real economic benefits.

Andrew Strong is a UK Chartered Engineer and Fellow of the IET with over 25 years of research and industrial experience including in the hightech manufacturing sector. More recently, with Cambridge Consultants, he has worked with clients to identify novel on-line measurement solutions for real-time process feedback, as well as novel manufacturing processes to replace legacy equipment.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Tool Edge PREPARATION ADVANCES

By WILLIAM SHAFFER, President Conicity Technologies

Maintaining pace machining new materials, machining existing materials, and keeping tooling costs in line can be a challenge. Cutting tool edge preparation is now being recognized as a key component in increasing metalcutting efficiency while decreasing tooling costs.

CONTROLLED EDGE PREP SHAPE AND SIZE DISTRIBUTION

Dealing with the continuous development of new materials being introduced into automotive, medical, and aerospace machining, merely "rounding" the tool cutting edges for edge preparation and focusing on uniform edge prep size control is not enough. Controlling metalcutting efficiency begins at the point of contact between the tool and work piece, where the "rubber meets the road". The edge preparation (microgeometry) at the point of contact not only protects the cutting edge providing increased corner strength, it is also a prime factor in directing cutting forces.

It is a known fact that the thickness of the uncut chip varies along the cutting edge on every tool, starting at the full chip thickness on the primary and transitioning down to a trace cut at tangency of the tool nose radius. If the ultimate goal is to keep the material removal process as efficient as possible; then, the size of the edge prep must be applied in such a fashion allowing it to vary, maintaining a proper size ratio with the thickness of the uncut chip. That means there are points along the cutting edge that will require a full amount of edge prep, other areas will have less than full, and some sections that must remain sharp. The need to precisely apply and vary the edge prep based on the size of the uncut chip has surfaced as the critical link between increased efficiency of material removal as well as being proven to be the key to economical dry machining.

POLYCRYSTALLINE DIAMOND

PCD tools are typically used to machine non-ferrous materials, such as high-silicon aluminum, metal matrix composites (MMC) and carbon fiber reinforced plastics (CFRP). PCD tool with flood coolant can also be used in titanium super-finishing applications. PCD tools are mainly used in a sharp edge condition and normally encounter relatively light chip loads. Most commonly, sharp edges, with no edge preparation, have been basically the only cutting edge condition option to date. PCD tooling failure normally begins with chipping or flank wear on the primary edge, where the cutting edge encounters the highest chip load. As flank wear continues to develop along the primary cutting edge, it begins to migrate into the secondary cutting edge, and finally reaching the adjacent edge where the cutting edge of the tool begins to rub and trap material. At that point semi-efficient metalcutting is replaced with tool rubbing and compression of the work piece. This tool edge wear condition eventually results in "pushing" the uncut chip over the exit side of the work piece forming a burr. The tool pressure developed from "pushing" the material to the outside edges of the work piece, especially in multi-tool milling heads, will also cause the surface of the work piece to become wavy and smeared. The two conditions concerning the PCD tool developing burrs or creating edge break-out appear over time after the tool has developed excessive flank wear on the cutting edges. The time it takes for the PCD tool to develop sufficient flank wear to create burrs or edge break-out determines the overall useable life of the tool.

To effectively extend the life of the PCD tool, proper and precise edge prep is used to delay the breakdown of the sharp cutting edge. Edge prep does not eliminate the failure mode; proper edge preparation is designed to delay the failure, thus extending useable tool life. This delay, created through additional corner strength, can yield a much needed increase in tool life.

THE NEED FOR VARYING THE EDGE PREP THICKNESS

In most machining involving PCD tools, chip loads are relatively light. If the tool is given an edge prep that is uniform in size and distribution, but the size of that edge prep exceeds the size of the chip load on the adjacent side of the tool, the tool will begin life cutting like it is worn. The tool will develop burrs from increased tool pressure, starting from the first part. Applying uniform edge preparation on PCD tools is one of the main reasons that edge prep on superhard tools has not been predictably successful. However, if the edge prep is applied where the edge prep size stays in ratio with the thickness of the uncut chip, tool life has been known to increase as much as 2 to 5 times. In the application of machining highly abrasive high silicon content aluminum engine blocks, in very abusive interrupted cutting, tool life in production was increased by a factor of 3:1, while creating a higher level of surface flatness and delaying burr formation.

VARIABLE EDGE PREP ON A PCD CUTTER *(Engineered Micro-Geometry EMG)*

In Figure 1, note the diminishing edge prep size from the primary cutting edge, (identified by the light grey band on the left side of the cutting edge) transitioning through the corner radius, decreasing in size as it approaches the adjacent side of the tool.

Figure 2, is a graphic representation of the changing chip load thickness as the tool feeds into the work piece from right to left.

PRECISION GROOVING IN ALUMINUM

Shown in Figure 2A and 2B are enlarged photos showing the size distribution of the variable edge prep on the cutting edges of the PCD piston grooving tool before machining. Edge prep size on the primary cutting edge is equal to .0007″ or 17 microns.

Figure 3 is an enlarged photo of the rake face surface of a PCD grooving tool used for machining automotive aluminum pistons. The chip thickness pattern exiting the work piece can easily be seen with the greatest chip flow located at the center of the primary cutting edge and tapering down in size as you approach the side tangencies of the tool. The chip load along with the edge prep reduces in size at the sides of the tool where the tool is developing the final width of the groove. At the side tangency of the tool, the groove width is at finished size and only a trace amount of stock is being removed. This is where the cutting edges of the tool need to remain in the original sharp condition. Results of machining a piston groove using variable edge prep is increased tool life, reduction of heat, reduced groove width distortion and greater finish size control.

HIGH SILICON CONTENT ALUMINUM MACHINING

In Figure 4a and 4b, the PCD tool shown is a photo of an insert that would be mounted in a multiple tool milling cutter used for machining aluminum engine blocks. The photo, Fig. 4a is the tool as received from the tool manufacturer. The tool in Fig. 4b is the tool after edge prep. In Fig. 4a the cutting edge surface of the PCD can be seen as being a bit rough mainly due to particle size of the PCD substrate. The cutting edges in the photo show the primary cutting surface of the tool. Visually, the smoothing effects and removing small surface flaws can be seen when comparing the two photo images. Tool life in this application was increased by a factor of 3:1.

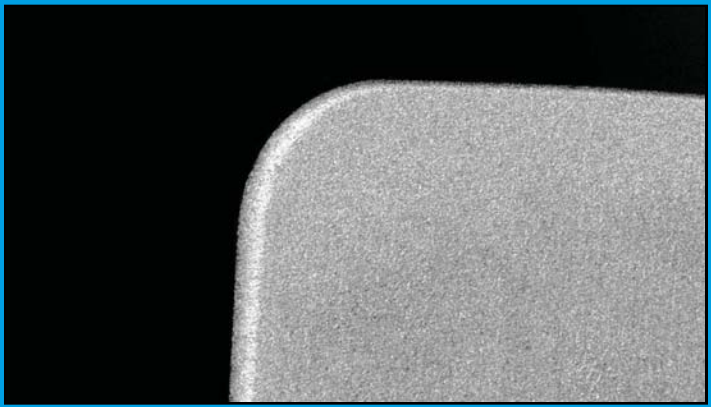


Figure 1 – (500 X Size)

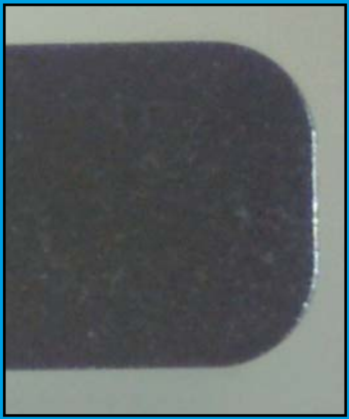


Figure 2A – New at 100X Size

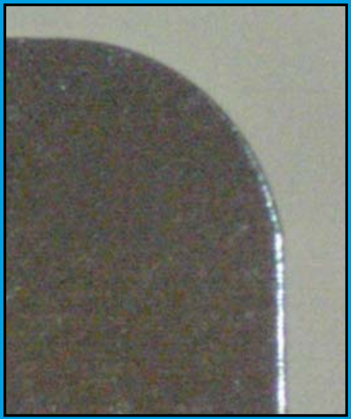


Figure 2B – at 200X Size

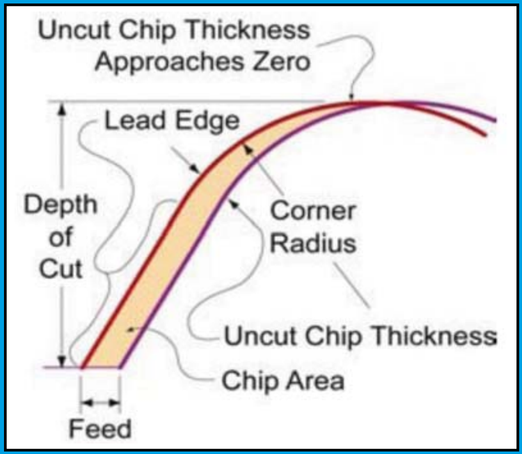


Figure 2

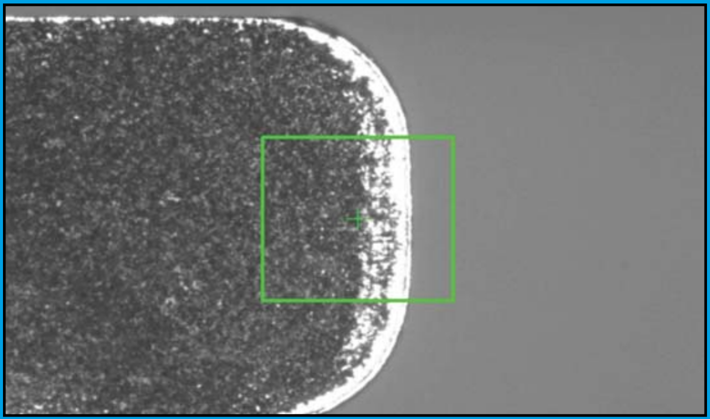
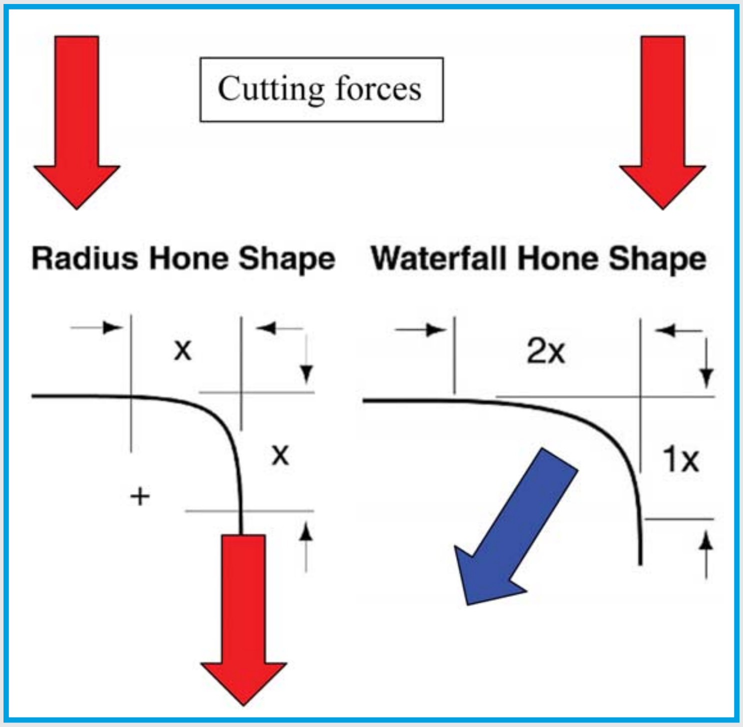


Figure 3 – Tool 2A After Use

FUNCTION OF THE EDGE PREP SHAPE

Directing Forces

It's the shape of the edge prep that largely determines the direction of cutting forces.



The radius shaped edge prep is centered on the corner of the cutting edge, with equal dimensions of the radius form on the rake face and flank face of the cutting edges. The cutting forces essentially remain vertical on the cutting edge, allowing a greater level of flank wear to form. Considering the waterfall shaped edge prep where the edge prep is shaped more like an oval, the cutting forces are directed deeper into the body of the tool, increasing life by reducing flank wear. The waterfall edge prep is extremely effective in protecting the cutting edge in highly interrupted cutting applications, such as milling, or broaching, keeping the cutting edge intact, where a sharp corner or radius style edge prep would tend to chip or fracture.

SIZE & SHAPE DO MATTER

Removing the sharpness to preserve the cutting edge on cutting tools through increasing corner strength, commonly referred to as "honing", is not new. However, correctly applying edge prep requires a balance of edge prep size verses the thickness of the chip load with consideration given to the tensile strength of the work piece material. In most machining applications, the edge prep is normally approximately 1/2 the thickness of the chip load. That edge-prep-to-chip-load-ratio typically is sufficient to protect the cutting edges from chipping and still keep tool pressure in check. Considering the chip load in metal cutting is small, in many cases, being less than the thickness of a human hair (.003"), the need to control the size of the edge prep, for the sake of tool performance and metal cutting efficiency, has become more apparent. The required accuracy and the need for tool-to-tool consistency immediately exceeded the ability of a machinist or machine operator to be effective in edge prepping tools by hand. The new, tougher, harder materials being

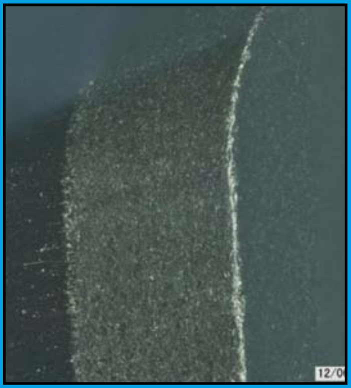


Figure 4A – Tool Life = 25,000 Parts

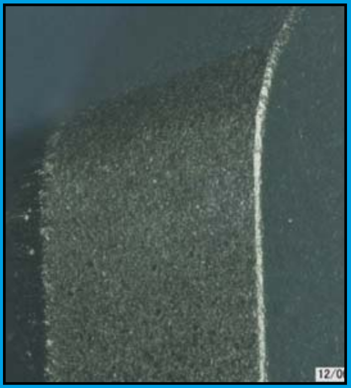


Figure 4B – Tool Life w/Edge Prep = 75,000 Parts

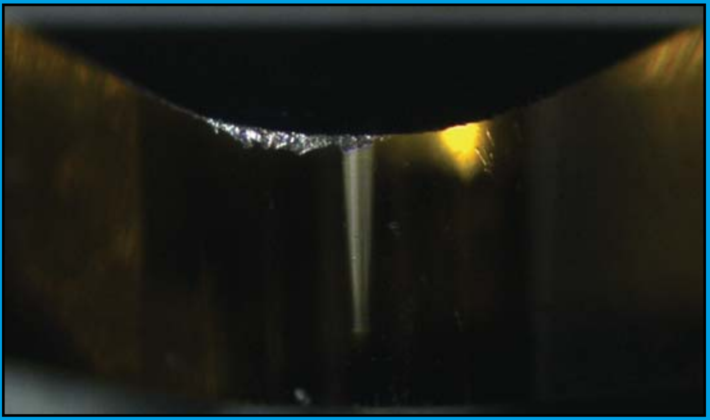


Figure 6A

Figure 5

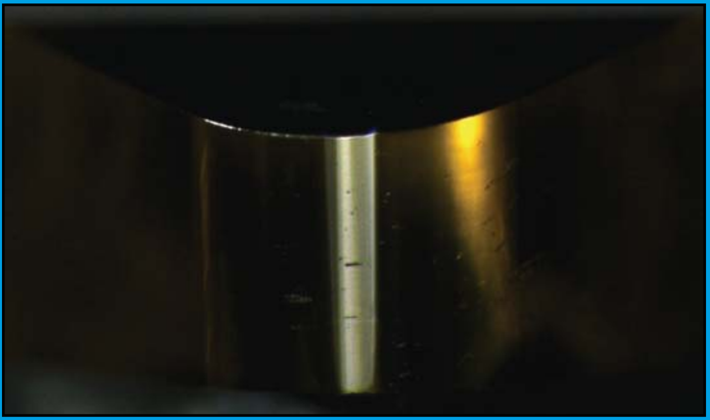


Figure 6B

IMTS NEW APPROACHES

TERRY KANE, Editor

Another IMTS is in the books and I do have a few lasting impressions. IMTS 2016 was full of new technology of course the machines were there in force and probably 3D Printing spearheaded what was new and improved! Whenever I traverse from hall to hall and across the walkway at McCormick Place, all the years I have been there come flooding back and there is a natural comparison that immediately comes to mind. While we do still see a few sets of dancing girls and lovelies handing out brochures, most of those are long-gone and definitely the more risqué have either gone the way of political correctness or been banned from the show floor all together!

Viewing the large machines humming away there was a stark contrast from days gone by. The machines were as large and impressive as ever but gone was the smoke rising from the floor and the overwhelming stench of burning oil and the dense fog hanging throughout the great hall ... Tremendous improvements in filtering and self-containment or the complete elimination of those types of lubricants and cooling oils have led to a cleaner and environmentally friendly work area.

As I walked the floors I was taken back at one surprising thing, the complete switchover to superabrasives has still not taken place! I was amazed to see the number of machines being promoted as high production and time-saving still mounted with conventional abrasives. Granted conventional abrasives still have their place in certain applications but when you are grinding and machining hardened steel, superalloys, ceramics, composites, etcetera and want quality, there is only one answer ... superabrasives! It is an old story from the time long ago we learned that diamond works best grinding tungsten carbide and then years later when cubic boron nitride (cBN) was the answer for hardened tool steels.

Over the years there has been a leapfrog effect of superabrasive technology and workpiece materials. As science came up with lighter, stronger and more wear resistant component materials, abrasive technologists invented better diamond and cBN types, improved coatings, special bond systems and of course CVD Diamond to work and finish these components! Today the spectrum is wide and impressive from Nano to large single crystals to do literally any job industry requires.

I have been in training where an instructor told the attendees that the answer to aluminum oxide burning is doing a finishing pass to remove the burn! Yes, that removes the burn but it neglects to address the surface damage left by the burning in the first place! Today we know that cBN grinds without burn and also leaves a workpiece with no surface damage and high integrity!

So, you can see why I was amazed to see so many conventional abrasives still being used around the hall. Most of the new machines are especially designed to take full advantage of superabrasives with interchangeable tooling, high speed spindles, high pressure coolant delivery and rapid part load and unload. I know there is always the issue of cost but I am reminded of a presentation many years ago when a scientist, after pointing out lower production rates, scrap, surface damage and environmental impact of conventional wheels, unequivocally stated, "Even if they give you a conventional wheel at no charge, you can't afford to use it!"

Learn more at the Superabrasive Materials, Principles and Applications Course this coming November. Visit **www.superabrasiveseducation.com** for complete details!

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introduced to manufacturing seemingly daily are creating a need for a different level of tool accuracy and tool mentality. There seems to be an endless supply of excellent cutting tool substrates, geometries, and coating combinations. However, the importance of the micro-geometry in the edge prep, at the point of contact between the tool and work piece, is key. The tools that worked "yesterday" are not completely adequate for machining the new materials and neither are the uncontrolled processes of hand honing tools or just rounding the corners to get strength. "Old-School" versus "New School".

BEYOND PCD TOOLS: SINGLE CRYSTAL DIAMOND

The benefits of carefully preparing the cutting edge of PCD and PcBN tools are increasingly appreciated by their users. Applying an Engineered Micro Geometry to single crystal diamond tools is however a whole new territory. Preliminary tests were carried out in collaboration with the Element Six Global Innovation Centre, based in the United Kingdom. High-pressure, high-temperature (HPHT) and chemical vapor deposited (CVD) single crystal diamond tools were given waterfall edge prep and subsequently subjected to an accelerated wear test. More information on this particular test can be found in the proceedings of Intertech 2015, with title "Performance of Single Crystal Diamond Tools in Metal Matrix Composite Machining". Figure 5 shows a snapshot of a single crystal tool in action in that test. The flank wear after the same experimental conditions of single crystal tools with and without waterfall edge prep is shown in Figure 6a and 6b. The results look promising with significantly less damage on the tool with edge prep. Further optimization and testing are under way. Could an engineered micro geometry be the end of "running in" single crystal diamond tools? Figure 5: Snapshot of a single crystal tool in action at the Element Six Global Innovation Centre (photo courtesy of Dr J. Hall, Element Six). Figure 6: Flank wear on worn HPHT single crystal tools in an accelerated machining test, (a) no edge prep, (b) with waterfall edge prep (photos provided by Dr F. Schoofs, Element Six).

Conclusion

Data collected in years of production PCD milling of aluminum strongly endorses that EMG delays burr formation, thus extending usable tool life. The mechanism for this reduction of burr formation is the ability of the edge prep to delay tool wear and the accompanying increase of tool pressure and heat in two ways.

- Proper edge preparation prevents minor defects in the primary cutting edge of the tool from manifesting themselves as rapid flank wear.
- EMG provides an edge preparation that is smaller in size than the width of the interface "band" between the cutting tool and the workpiece (chip thickness). This allows the tool to cut more efficiently requiring less pressure by promoting clean cutting along the entire cutting edge.

Moving forward, backed by the successful edge prep of PCD, extending edge prep technology to single crystal tools is a natural progression. With the promise of increased corner strength, chip resistance and improved surface finish offered by precise edge prep, as it has been proven in PCD, the application range of both PCD and the potential improvements in single crystal tools will certainly expand allowing diamond tools in general to become even greater players in the world of machining and material removal.

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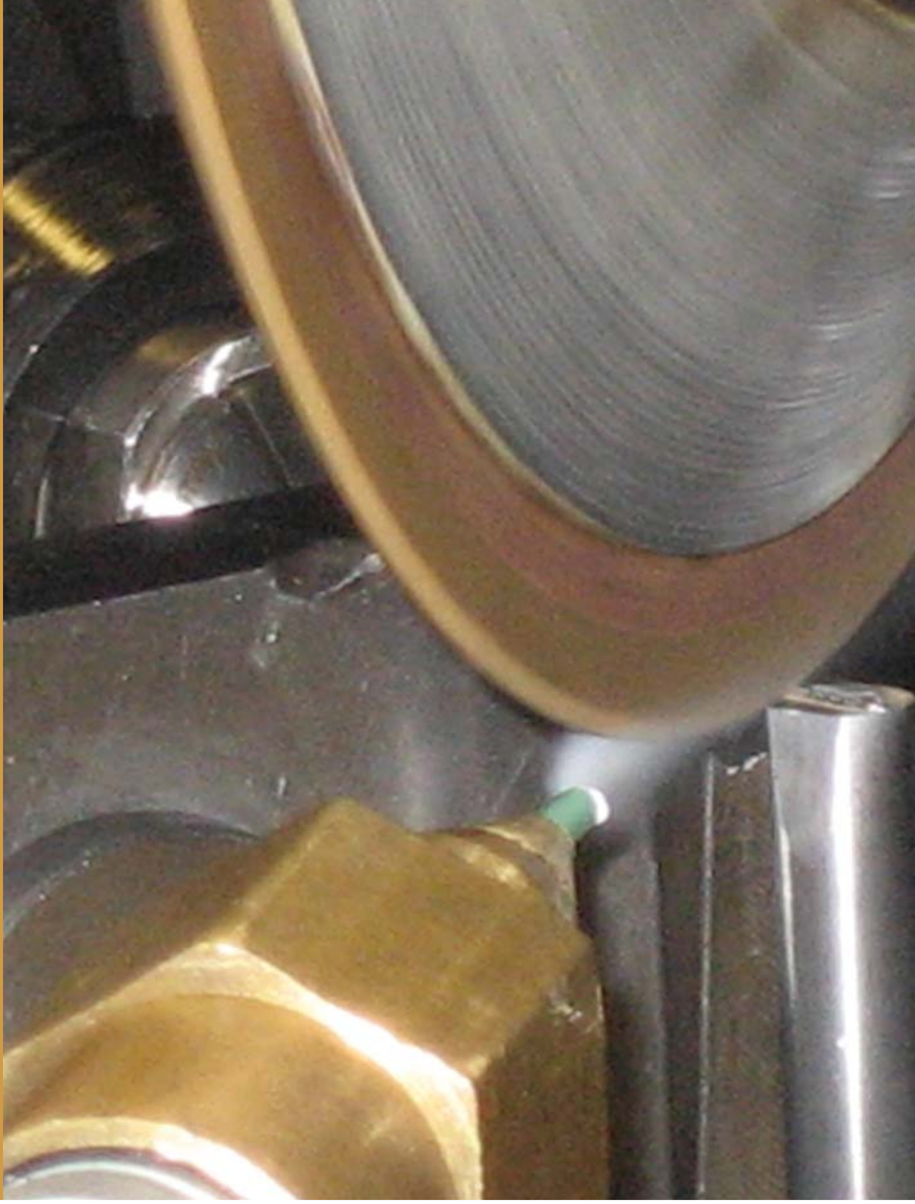
ATMOSPHERE Optimized

Tunable MQCL™ Systems for Precision Abrasive Grinding

By Harry G. Sachsel, CAE
Diamond Industrial Tools
www.Todit.com

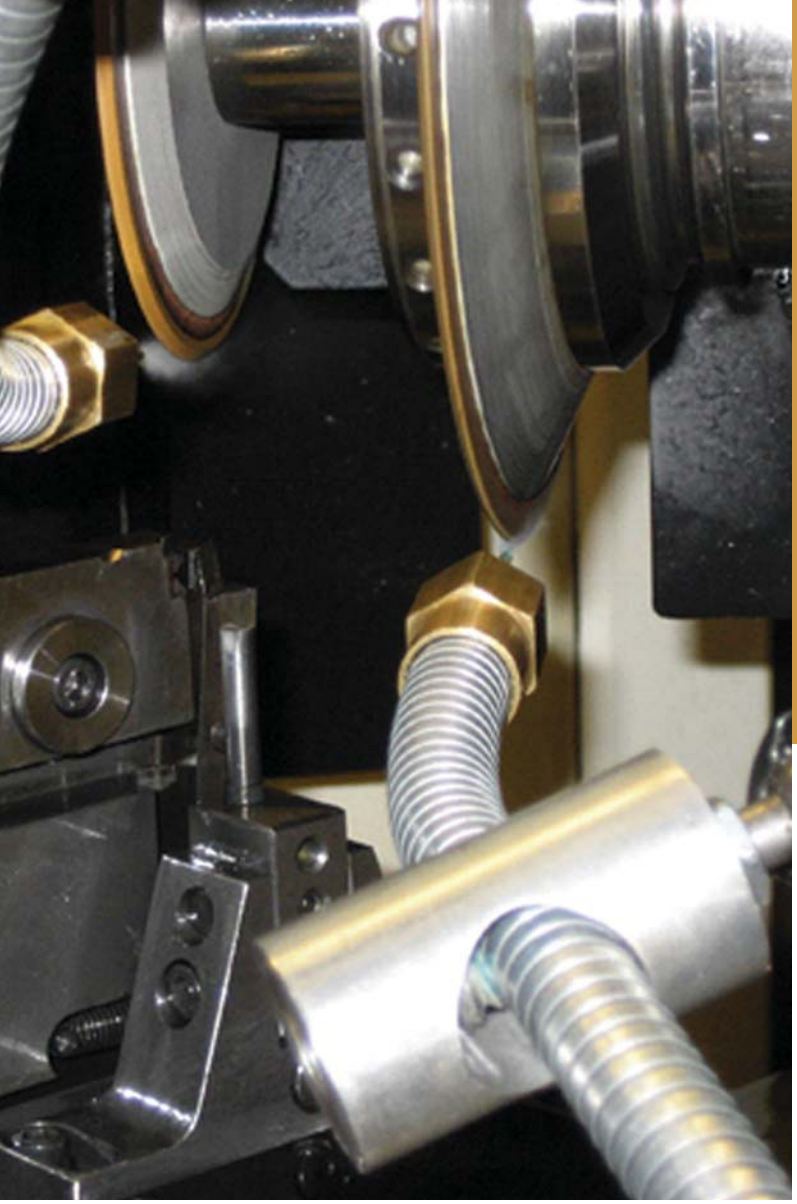
The past century has witnessed significant advancements in grinding machines, abrasive cutting tools, machine controls, processing materials, and cooling-lubrication chemistries. However, surprisingly very little has changed with regards to the application of coolants and lubricants during precision abrasive grinding – *the machining atmosphere*. Many precision abrasive grinding processes employ a flooding coolant spray which is as old as the grinding process itself. The (wet) flooding process serves several functions – cooling, lubrication, and chip management – and is easily adapted to grinding wheels. Countless coolant and lubricant formulations are available. However performance tradeoffs emerge between optimal lubricity and cooling power, and the need for dry processing of superhard materials. Although flooded cooling lubrication has been the benchmark up to now, it may be a good time to consider a change.

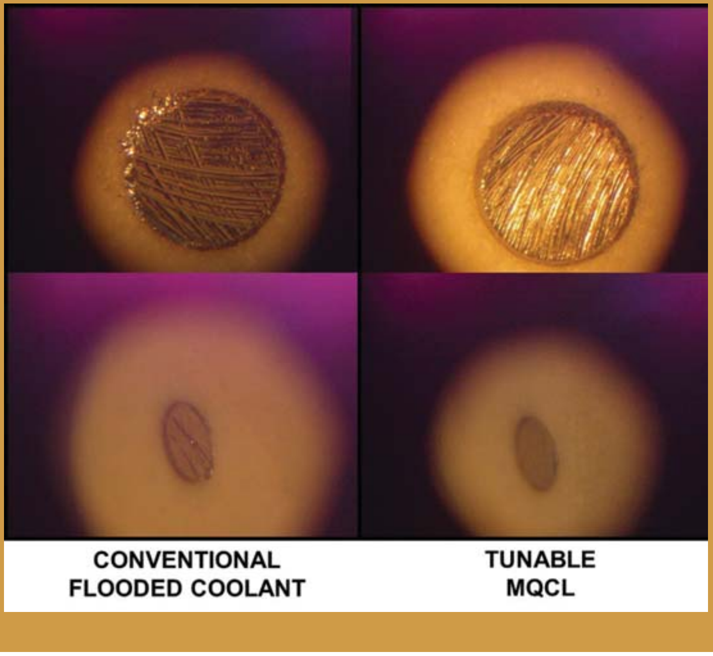


In the past, flooding was necessary to compensate for excessive heat generated due to the inferior performance of grinding processes, tools, machines, and cooling lubricant chemistries. Mounting evidence in the academic and industry literature indicates the many benefits of newer dry and near-dry cooling lubrication techniques. One such technology is Tunable Minimum Quantity Cooling Lubrication (or simply Tunable MQCL™), developed specifically to optimize machining processes involving extremely hard, abrasive, and low thermal conductivity materials such as superalloys and ceramics. Tunable MQCL employs infinitely-adjustable compositions of (optional) ionized oil droplets and additives, compressed air, and carbon dioxide (CO2) coolant-lubricant. The benefits of Tunable MQCL include better machining economics, water and energy savings, and less waste by-products. For example, Tunable MQCL is shown to perform much better than dry or wet processing in precision abrasive grinding applications, which require powerful (and preferably dry) cooling lubrication action. Successful application of Tunable MQCL results in improved productivity, longer hard tool life, and better surface finish. Tunable MQCL embodies the "less is more" principle, with compositions ranging from completely dry to near-dry – and without sacrificing lubricity and cooling power. Tunable MQCL is an opportunity to provide better performance using substantially less energy, labor, and time resources.

Tunable MQCL is a process-adaptable machining atmosphere providing optimal chemistry, pressure, temperature, and ionization for a cutting system – hard workpiece, tool, and machining process. Innovative companies and end-users are adapting Tunable MQCL to challenging machining processes such as precision abrasive grinding. Precision abrasive grinding is an application which represents huge payback potential in terms of both productivity and quality due to superior heat management capabilities with minimal disruption. However, it is very challenging to adapt Tunable MQCL technology to the enormous range of precision machining systems due to the aforementioned built-in flood coolant equipment design constraints.

A new collaborative robot (co-bot) tending system called SprayTender™ represents a virtually unlimited machine adaptation solution for Tunable MQCL. The SprayTender co-bot platform, equipped with customizable end-effectors, works cooperatively with the machining system (and operator) to provide multiple functions such as pick-and-place, M-Code selection and application of machining atmospheres during precision abrasive grinding, deburring, cleaning, and inspection. The SprayTender co-bot is compact, human and equipment safe, highly flexible, and represents the new paradigm in machine tending automation. Machine operators can program the SprayTender with multiple cooling-lubrication paths is just a





few minutes. The combination of tunable dry to near-dry machining atmospheres and co-bot automation represents a new benchmark for the machining and precision abrasive grinding industry.

A DOZEN GREAT REASONS FOR USING TUNABLE MQCL CO_2 SYSTEMS

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    - Expansion: Air- CO_2 (g) + surface heat • Air – CO_2 (g)
    - Radiation: CO_2 (s/l/g) + IR hear • CO_2 (g)
    - Endothermic: CO_2 (g) + Juvenile Metal (M J) MC, MO (s)
4. CO_2 absorbs infrared (IR) radiation (thermal radiation) from the entire machining system which keeps the tool, workpiece, and atmosphere cooler.
5. Fully-adjustable cooling-lubrication spray chemistry control- 100% dry to near-dry.
6. Employ optional Minimum Quantity Lubricant (MQL) additives- oxygenated and super spreading vegetable-based cutting oils, high boiling alcohols and EP additives.
7. React selectively with tool/workpiece surfaces to form tribochemical films such as metal carbides and oxides which protect hard tool surfaces from rapid degradation.
8. Passive and electrostatic charging and ionization of air, CO2 and additives accelerates film formation, micronizes MQL droplets and increases surface cooling rates.
9. Selectively control the O_2 content in the cutting atmosphere- intensify or minimize.
10. Chemically clean surfaces free of residual MQL, cutting particles and carbonaceous residues.
11. Adaptable to multiple machining systems and tools, including robotic machine tending.
12. Improve productivity, lower production cost and enhance environmental, health and safety.

Ultimately, next generation CNC precision abrasive grinding centers specifically designed for dry and near-dry cooling lubrication technology will be needed for widespread adoption of Tunable MQCL. The precision abrasive grinding industry – system, tool, coolant-lubricant, and accessory equipment manufacturers and suppliers – represent the gatekeepers in this regard. Their participation is critical for realizing the multiple benefits afforded by Tunable MQCL technology. Grinding tools last longer, grinding processes produce parts faster and cleaner, less (or no) wet coolant is needed, and coolant management systems are needed less.

These exemplary outcomes represent a very disruptive potentiality for the industry. However a change in atmosphere – in terms of both industry mindset and technological practice – promises to deliver significant economic and environmental benefits to end-users and society alike. ●

****Atmosphere, Optimized, Tunable MQCL™ Content and Photos © CleanLogix LLC***

NEWS & notes

IMTS 2016 THIRD LARGEST SHOW FOR REGISTRATION AND EXHIBIT SPACE, ALSO SHOWCASED HIGHEST NUMBER OF EXHIBITORS IN HISTORY

McLean, Va. (Sept. 21, 2016) – IMTS – The International Manufacturing Technology Show today released the final numbers for IMTS 2016, which ran from September 12 – 17 at Chicago's McCormick Place. IMTS 2016, the 31st edition of the show, was the third largest in number of registrations (115,612) and in net square feet of exhibit space (1,370,256). This show hosted the highest number of exhibiting companies ever (2,407). After move in, the building was 76 million pounds heavier. "IMTS has grown not only in size, but in the overall scope of manufacturing," says Peter R. Eelman, Vice President – Exhibitions & Business Development at AMT – The Association For Manufacturing Technology, which owns and manages IMTS. "There are more compelling reasons for people to attend. Whether they come to research new technology, evaluate vendors before purchasing, find solutions or connect with the leaders in the manufacturing industry. The dominant technologies at IMTS 2016 were additive manufacturing, robotics automation and an increasing digital thread, according to Tim Shinbara, AMT Vice President – Manufacturing Technology.

THE ILJIN DIAMOND USA TEAM, ANNOUNCES JEREMY PETERSON IS NEW TECHNICAL SALES MANAGER

Jeremy brings his 23 years of experience in the superabrasives industry to the Iljin team with previous roles in manufacturing, applications, technical service and sales. Please feel free to contact Jeremy or any other of the Iljin Diamond USA team at: ILJIN USA, INC. 11999 Katy Freeway Ste. 605, Houston, TX 77079, USA T. 281.448.5111 diausa@iljin.co.kr

BOEING FORECASTS DEMAND FOR 39,620 NEW AIRPLANES VALUED AT $5.9 TRILLION

20-year Current Market Outlook reflects 4.1 percent increase in new airplane deliveries over 2015 forecast – Single-aisle demand driving growth.

Boeing [NYSE: BA] projects a demand for 39,620 new airplanes over the next 20 years, an increase of 4.1 percent over last year's forecast, estimating the total value of those new airplanes at $5.9 trillion. Despite recent events that have impacted the financial markets, the aviation sector will continue to see long-term growth with the commercial fleet doubling in size. Passenger traffic will grow 4.8 percent a year over the next two decades and the single-aisle market will be especially strong, with low-cost carriers and emerging markets driving growth. On the widebody side, 9,100 airplanes are in the forecast, with a large wave of potential replacement demand in the 2021- 2028 time frame. Boeing projects a continued shift from very large airplanes to small and medium widebodies such as the 787, 777 and 777X. With cargo traffic forecasted to grow at 4.2 percent per year, Boeing projects the need for 930 new freighters and 1,440 converted freighters. The Asia market, including China, will continue to lead the way in total airplane deliveries over the next two decades. The full report can be found at www.boeing.com/cmo.

STRONGEST TITANIUM ALLOY AIMS AT IMPROVING VEHICLE FUEL ECONOMY AND REDUCING CO2 EMISSIONS

An improved titanium alloy, claimed to be stronger than any commercial titanium alloy currently on the market, is reported to get its strength from the novel way atoms are arranged to form a special nanostructure. For the first time, researchers have been able to see this alignment and then manipulate it to make a low-cost beta-titanium alloy with high strength. As noted in a paper published by Nature Communications, the material is an excellent candidate for producing lighter vehicle parts and that this new found understanding may lead to creation of other high strength alloys. For instance, aluminium is a less expensive metal and if the nanostructure of aluminium alloys can be seen and hierarchically arranged in a similar manner, that would also help the auto industry build lighter vehicles that use less fuel and put out less carbon dioxide that contributes to climate warming. For complete story visit: http://www.pm-review.com/strongest-titanium-alloy-aimsat-improving-vehicle-fuel-economy-and-reducing-co2-emissions/

Calendar of EVENTS

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www.csda.org/events/EventDetails.aspx?id=820349

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http://www.advancedmfg.ca/event-overview

NOVEMBER 9-11, 2016
Carbon Fiber 2016
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www.CarbonFiberEvent.com

NOVEMBER 16-17, 2016
Industrial Diamond Association of America
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NOVEMBER 17-22, 2016
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2016 EDITORIAL CALENDAR

Planned issues, topics and closing dates*:

Issue:	Editorial Feature*:	Closing
Winter 2015/2016	Lasers in Superabrasive Processing	Dec. 15, 2015
Spring 2016	CVD Diamond Products and Applications	Mar. 15, 2016
Summer 2016	IMTS Preview, Education and Innovative Technology	June 15, 2016
Fall 2016	Diamond, cBN and Polycrystalline Materials	Sept. 15, 2016
Winter 2016/2017	Superabrasive Industry Review	Dec. 15, 2016

***Editorial topics & closings subject to change**

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Provide names of principle officers or partners: ______________________

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List at least two business references which are current IDA REGULAR MEMBERS. REQUIRED for Consideration

1. ______________________
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CHECK APPROPRIATE MEMBERSHIP

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Any company and/or individual classified as a superabrasive/ultra-hard material supplier, tool maker, machine tool builder or related business which HAS an office and a local, state or province business license in the United States, Canada or Mexico is eligible for membership in this category. Only one individual shall be designated by each member company as the IDA Delegate with voting and other privileges described in the By-Laws.

(DUES CATEGORY)

The dues category for Regular Members is determined by annual sales volume expressed in US $ as indicated below. Check to appropriate category:

_____	Category 1	$2,750 per year	Over $20,000,000 Annual Sales
_____	Category 2	$2,090 per year	$10,000,000 - $19,999,999 Annual Sales
_____	Category 3	$1,850 per year	$6,000,000 - $9,999,999 Annual Sales
_____	Category 4	$1,450 per year	Under $2,000,000 - $5,999,999 Annual Sales
_____	Category 5	$1,095 per year	Under $1,999,999 Annual Sales

_______ **International Membership**

Any company and/or individual in the diamond and/or cBN business which DOES NOT have an office and a local, state or province business license in the United States, Canada or Mexico is eligible for membership in this category. An International member shall have all the privileges of regular membership, except that he/she cannot vote at any membership meetings, participate in statistical reporting for the North American market, hold proxies or serve in any office in IDA. Annual fee for International Member is **$3990 per year**.

_______ **Associate Membership**

Available for companies having a principal office in the U.S.A., Canada or Mexico, which are ***providing products or services to companies within the superabrasive/ultra-hard material industry***, but are not engaged in selling, using or dealing in industrial diamonds, cubic boron nitride, compacted diamond/cbn, diamond film or products containing diamonds/cbn. An Associate member shall have all the privileges of regular membership. Annual fee for an Associate is **$600 per year**.

_______ **End User/Contractor Membership**

Available for any global companies or individuals, which USE products classified as superabrasives or ultra-hard materials, but are *NOT ENGAGED IN SELLING* industrial diamonds, cubic boron nitride, compacted diamond/cbn, diamond film or products containing diamonds/cbn. An End User/Contractor member shall have all the privileges of regular membership, except that the Delegate cannot vote at any membership meetings, participate in statistical reporting for the North American market, hold proxies or serve in any office in IDA. Annual fee for an End User/Contractor is **$400 per year**.

_______ **Academia/Research Membership**

Any non-profit Academic institution or R & D organization is eligible for membership in this category. An Academia/Research/ member shall have all the privileges of regular membership, except that the Delegate cannot vote at any membership meetings, participate in statistical reporting for the North American market, hold proxies or serve in any office in IDA. Annual fee for Academia/Research is **$175 per year**.

_______ **Student Membership**

Any FULL TIME Student *NOT ENGAGED IN SELLING* industrial diamonds, cubic boron nitride, compacted diamond/cbn, diamond film or products containing diamonds/cbn is eligible for membership in this category. A Student shall have all the privileges of regular membership, except that he/she cannot vote at any membership meetings, participate in statistical reporting for the North American market, hold proxies or serve in any office in IDA.Annual fee for a Student Membership is **$100 per year**.

_______ **Senior Membership**

Any individual who has worked for and/or retired from an IDA Member company or is no longer active in the diamond or CBN business is eligible for membership in this category. A senior member shall have all the privileges of regular membership, except that he/she cannot vote at any membership meetings, participate in statistical reporting, hold proxies or serve in any office in IDA. Annual fee for a Senior is **$75 per year**.

Name of Delegate Member: ______________________

Title: ______________________

E-Mail: ______________________

**** Applications for ALL Memberships are reviewed by the Board of Directors and must be approved by a two-thirds vote.***

_______ **Affiliate Membership**

Each company that enrolls as an IDA Member is entitled to have a second person at that company designated an Affiliate Member. The first Affiliate member will receive IDA material at no further cost. Additional persons at Member companies can be added as Affiliate Members to receive IDA materials. Annual fee for additional Affiliates is $100 per person. Name of 1st Affiliate Member (no charge):

Name of 1st Affiliate Member (no charge): ______________________

Name of 2nd Affiliate Member ($100): ______________________

Name of 3rd Affiliate Member ($100): ______________________

If your company wants more Affiliate Members, please attach additional sheets.

WHAT IS THE IDA?

The Industrial Diamond Association of America, Inc. **is a non-profit trade association and was incorporated on March 29, 1946 in the State of New York. It is the oldest and most prestigious association in the superabrasive/ultrahard materials industry. Activity and focus has evolved from natural diamond to superabrasives and most recently, to all ultrahard materials including CVD Diamond. Members include material suppliers, tool manufacturers, component producers, machine tool builders, end users, academia/research affiliates and other companies related to the research, manufacture, application, use and sales of superabrasives.**

WHAT DOES THE IDA DO?

- ◆ **Oversees Statistics Reporting Program**
- ◆ **Establishes Industry Standards**
- ◆ **Interacts With Global Associations And Organizations**
- ◆ **Creates And Distributes Market Studies & Data**
- ◆ **Organizes And Presents Technical Seminars & Conferences**
- ◆ **Serves As A Government Liaison For Industry Guidelines And Regulations**
- ◆ **Participates As Member Of World Diamond Council**
- ◆ **Provides Safety / Regulatory Reports And Advisement**
- ◆ **Resource For General Information And Consultation**

OTHER MEMBER SERVICES

- ◆ **PUBLISHES QUARTERLY MAGAZINE**
- ◆ **HOLDS ANNUAL CONVENTIONS**
- ◆ **HOSTS IDA WEBSITE WITH MEMBER FOCUS AND DIRECTION**
- ◆ **PROVIDES SPECIFIC ASSISTANCE ON INDIVIDUAL MEMBER ISSUES**
- ◆ **CREATES AND DISTRIBUTES PUBLICATIONS ON PRODUCTS AND APPLICATIONS**
- ◆ **ACTS AS A COLLECTIVE VOICE FOR INDUSTRY CONCERNS**

FAX completed membership form to 614-797-2264

Finer Points
CHECKLIST OF THINGS TO DO

- ☐ Renew my subscription to Finer Points magazine.
- ☐ Reserve my ad space in the next Finer Points issue.
- ☐ Submit article for consideration in future Finer Points issue.
- ☐ Send Finer Points my business news, new products, new hires, promotions, industry news and other press release items.
- ☐ Send in my membership application to the IDA.
- ☐ Refer a company to IDA for consideration as a member.
- ☐ Visit the IDA Website at: www.superabrasives.org.
- ☐ Contact an IDA member for products or services.

We Are
Not Alone

There's a wonderful world around us. Full of fascinating places. Interesting people. Amazing cultures. Important challenges. But sadly, our kids are not getting the chance to learn about their world. When surveys show that half of America's youth cannot locate India or Iraq on a map, then we have to wonder what they do know about their world.

That's why we created MyWonderfulWorld.org. It's part of a free National Geographic-led campaign to give your kids the power of global knowledge. Go there today and help them succeed tomorrow. Start with our free parent and teacher action kits. And let your kids begin the adventure of a lifetime.

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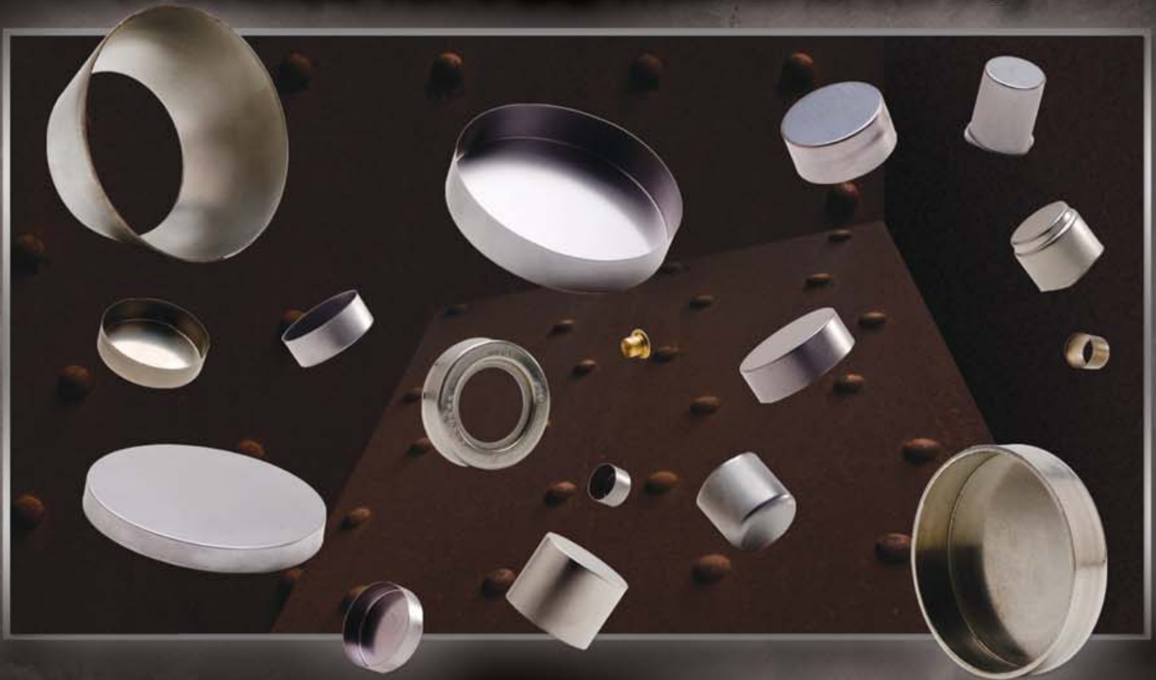

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QUALITY Our design, tooling and quality management system produces the fits, tolerances, surface finish and cleanliness demanded by the superabrasives industry.

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